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Kelly et al.

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[54] **MAGNETIC DOOR LOCK WITH TIME DELAY OPTION**

[75] Inventors: **Michael A. Kelly**, Felton; **Bruce G. Beigel**, Seven Valleys, both of Pa.; **Emmanuel L. Logan, Jr.**, Columbia, Md.

[73] Assignee: **Reliable Security Systems, Inc.**, Cockeysville, Md.

[21] Appl. No.: **860,926**

[22] Filed: **May 8, 1986**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 700,867, Feb. 12, 1985, Pat. No. 4,652,028.

[51] **Int. Cl.**[4] **E05C 17/56**

[52] **U.S. Cl.** **292/251.5**; 292/DIG. 65

[58] **Field of Search** ..... 292/251.5, 92, 201, 292/144, DIG. 65

[56] **References Cited**

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3,426,166	2/1969	Canceill	292/251.5 X
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4,257,631	3/1981	Logan, Jr.	292/251.5
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4,314,722	2/1982	Logan, Jr. .	
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4,328,985	5/1982	Logan .	
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4,487,439	12/1984	McFadden	292/251.5
4,516,114	5/1985	Cook .	
4,540,208	10/1985	Logan, Jr. et al. .	
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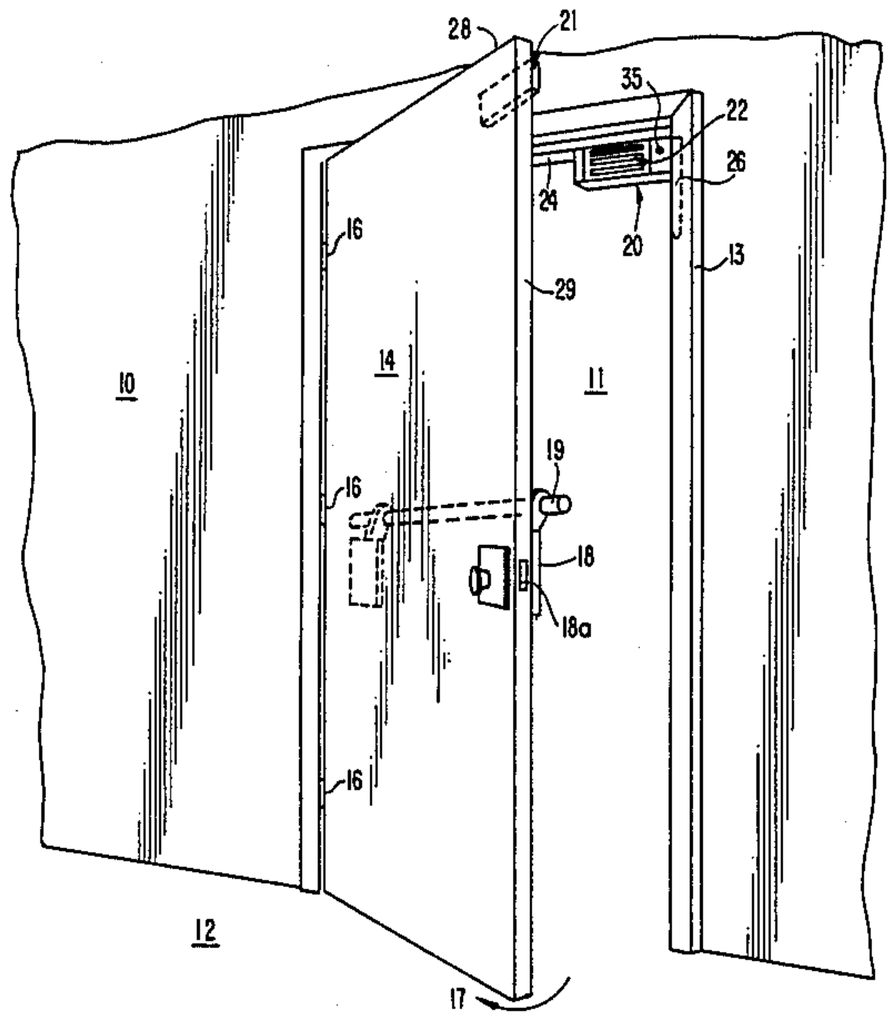
Primary Examiner—Richard E. Moore

Attorney, Agent, or Firm—Millen & White

[57] **ABSTRACT**

A magnetic door lock with a time delay option includes an electromagnet mounted on a door frame and an armature mounted on a door. The electromagnet has a pair of laterally spaced slots therein which each have a reed switch therein for monitoring magnetic flux in the electromagnet. When the armature is engaged with the electromagnet, the magnetic flux is at a selected level sufficient to close the reed switches. If, due to tampering or some other reason, the magnetic flux drop does not reach the selected level, at least one of the reed switches will remain open indicating that the armature is not securely engaged with the electromagnet. The door lock also includes separate mounting plates for mounting the electromagnet and armature so that the electromagnet and armature will be properly aligned when mounted. A plunger is provided adjacent the electromagnet for engagement by a block adjacent the armature. When an attempt is made to open the door, the plunger moves thereby sensing the attempt. The plunger negates the need for an electric hinge for carrying current across the gap between the door and door jamb.

8 Claims, 8 Drawing Figures



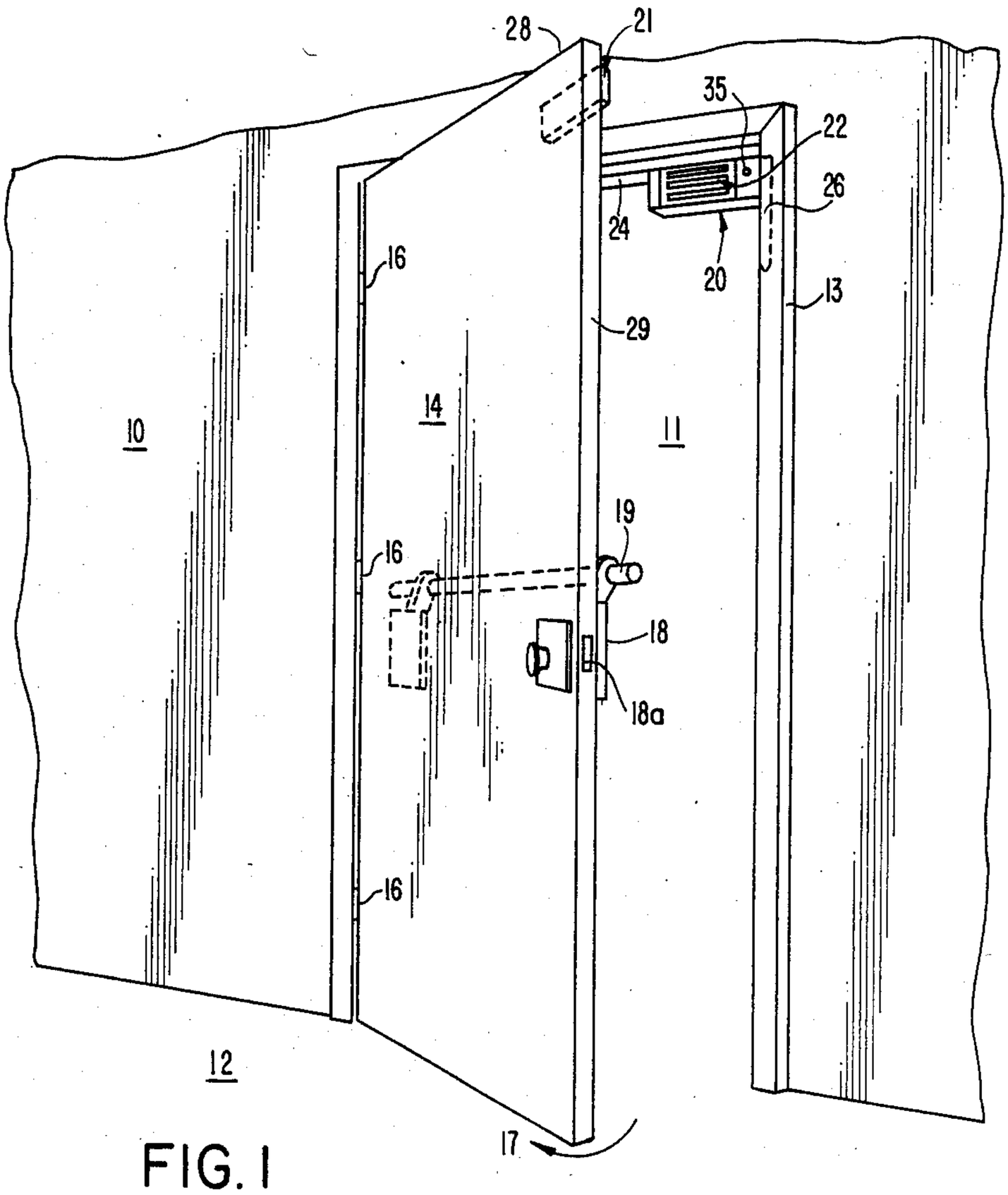

28
21
35
22
26
24
20
16
13
29
14
11
10
19
16
18
18a
16
12
17

FIG. 1

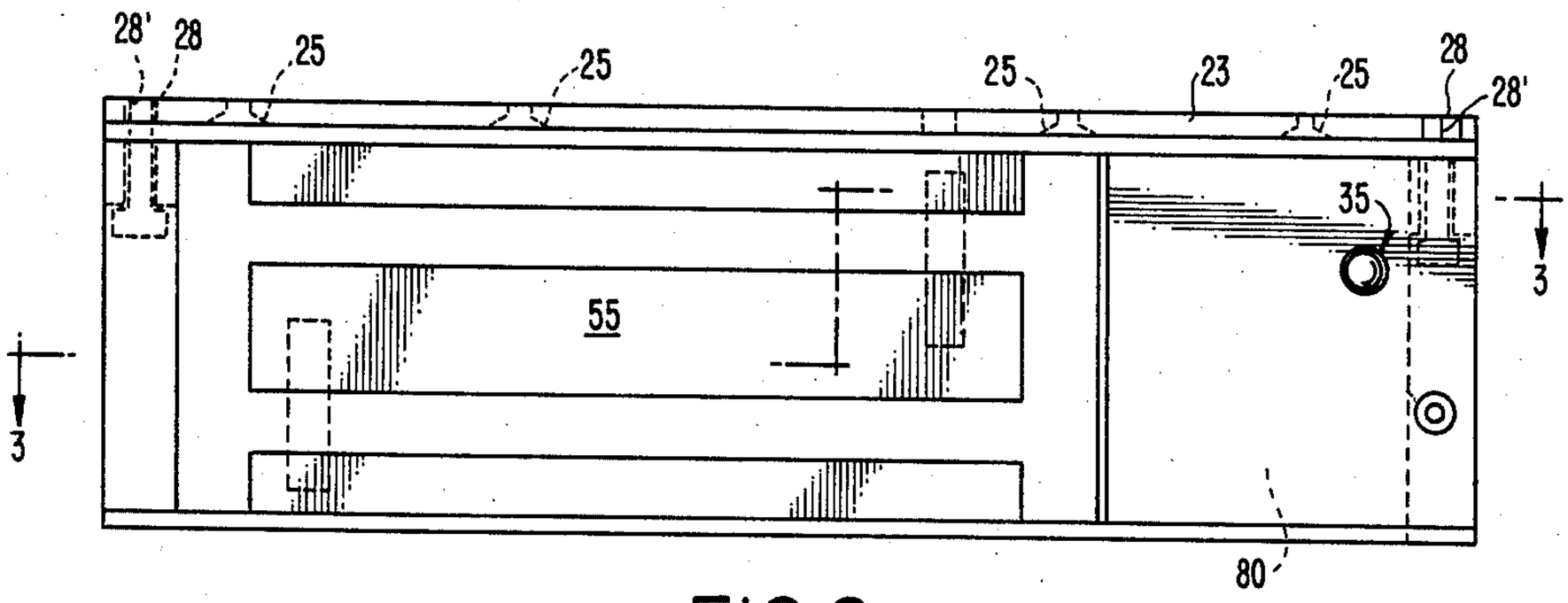

28'
28
25
25
25
23
25
28
28'
35
3
55
3
80

FIG. 2

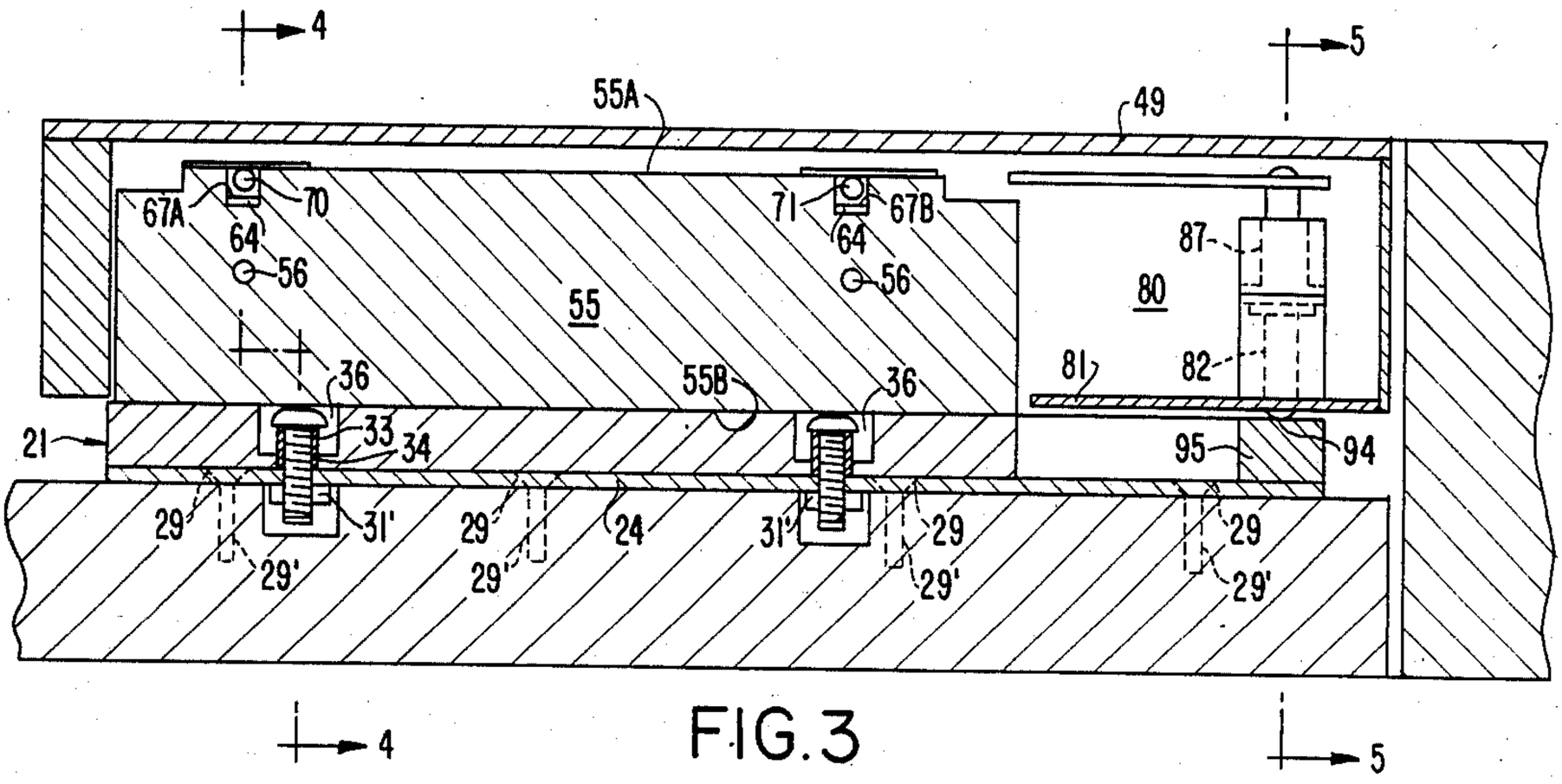


FIG.3

FIG.4

FIG.5

FIG.6

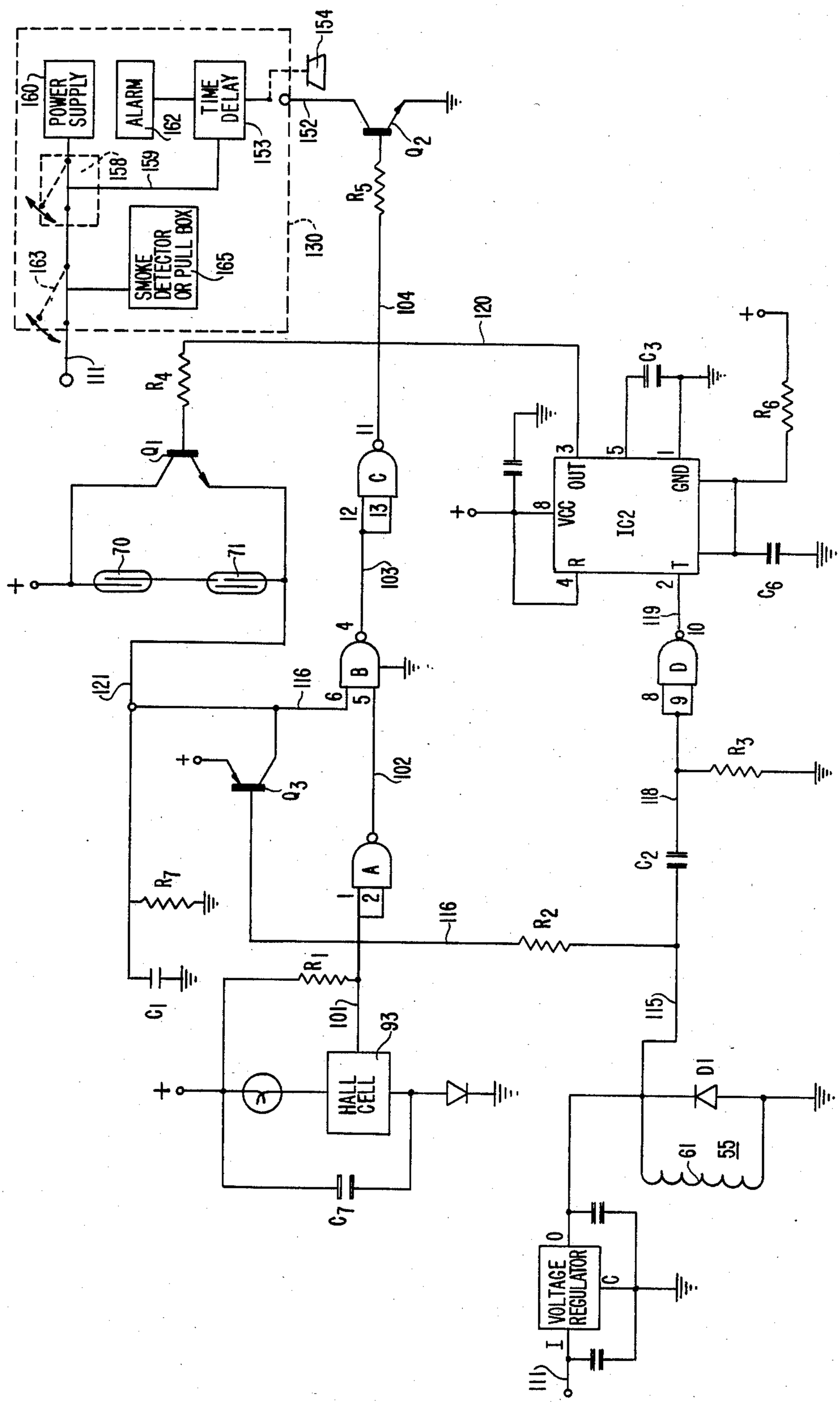

160
POWER SUPPLY
ALARM
162
TIME DELAY
153
154
152
Q2
R5
158
159
163
SMOKE DETECTOR OR PULL BOX
165
130
104
120
111
R4
Q1
11
C
12
13
103
70
71
IC2
OUT
VCC
GND
R
T
C3
R6
C6
121
116
4
B
6
5
102
Q3
A
1
2
R7
C1
R1
101
93
HALL CELL
C7
R2
C2
119
10
D
8
9
R3
118
115
D1
61
55
VOLTAGE REGULATOR
I
O
C

FIG. 7

MAGNETIC DOOR LOCK WITH TIME DELAY OPTION

CO-PENDING APPLICATION

This application is a continuation-in-part application of U.S. application Ser. No. 700,867, filed Feb. 12, 1985, now U.S. Pat. No. 4,652,028, issued Mar. 24, 1987.

RELATED UNITED STATES PATENTS

"Emergency Exit Door Latching and Locking Apparatus", Ser. No. 22,110, filed Mar. 3, 1979, now U.S. Pat. No. 4,351,552.

"Point of Egress Control Device for Securing Exit Door Safely", Ser. No. 929,968, filed Aug. 1, 1978, now U.S. Pat. No. 4,324,425.

"Magnetic Emergency Exit Door Lock with Delayed Opening", Ser. No. 051,724, filed June 25, 1979, now U.S. Pat. No. 4,257,631.

"Timing Delay for Emergency Exit Door", Ser. No. 125,995, filed Feb. 29, 1980, now U.S. Pat. No. 4,328,985.

"Timing Apparatus for Delaying Opening of Doors", Ser. No. 089,398, filed Aug. 10, 1979, now U.S. Pat. No. 4,314,722.

"Point-of-Egress Control Device Safely Securing Emergency Exit Doors", Ser. No. 148,403, filed May 9, 1980, now U.S. Pat. No. 4,354,699.

"Emergency Exit Door Latch with Hydraulic and Electronic Delay", Ser. No. 263,955, filed May 15, 1981, now U.S. Pat. No. 4,470,625.

"Point-of-Egress Control Device for Safely Securing Emergency Exit Doors", Ser. No. 423,523, filed Sept. 27, 1982, now U.S. Pat. No. 4,540,208.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The instant invention relates to magnetic locks. More particularly, the instant invention relates to emergency exit door security systems wherein the system includes a magnetic door lock which senses when an attempt is made to open the door and/or senses when the lock is not secure.

2. Technical Considerations and Prior Art

The numerous patents listed above as "Related Patents" are generally directed to devices for delaying opening of emergency exit doors to prevent unauthorized exit from a building or room. Of particular interest with respect to the instant invention is U.S. Pat. No. 4,257,631, "Magnetic Emergency Exit Door Lock with Delayed Opening". As is readily apparent from the disclosure of this patent, initiation of a delayed time, opening interval is effected by pushing on the panic bar of the emergency exit door. The panic bar depresses a plunger of a switch, which switch in return is connected to time delay circuitry. Since the time delay circuitry is not disposed on the door, the line connecting the time delay circuitry to the switch must "jump the gap" between the hinged edge of the door and the door frame. In order to solve this problem, an "electric hinge" is utilized, which hinge has conductors and/or connectors therein for carrying current across the gap. These hinges are very expensive and are frequently difficult to select. This is because it is preferable that an electric hinge match the hinge set which a door is designed to accept. Frequently, a matching electric hinge is not available. In order to connect the switch to the time delay circuitry, a wire is usually run through the interior of the door to the electric hinge. Thereafter, the wire is run from the door jam side of the hinge through the door jam or wall to the circuitry. Running these wires is a time consuming, expensive operation.

In addition to the economic considerations, there are mechanical and safety considerations. There are numerous types of panic bars now on the market with which the switch must be mated. Accordingly, it is frequently difficult to configure the design and location of the switch so that it will operate with the particular panic hardware under consideration. Moreover, in many installations, the switch is exposed and therefore subject to damage and vandalism. Consequently, the switch may not operate properly when there is a need to open the emergency exit.

The assignee of the inventors named in the instant application has found that there is a market for magnetic locks both with the time delay feature and without the time delay feature. This is because it is frequently necessary, for one reason or another, to provide an indication that someone is attempting to open an emergency exit door. This indication may be used to start a time delay count in accordance with the principles disclosed and claimed in the aforelisted "Related Patents" or may simply be used to trip an alarm. For whatever reason, existing door security systems utilizing magnetic locks need a convenient, reliable and inexpensive way to provide such indication.

The prior art includes U.S. Pat. Nos. 4,487,439; 4,516,114 and 4,287,512 which address at least some of the concerns with which the instant invention deals. U.S. Pat. No. 4,487,439 discloses an electromagnetic lock with a floating armature which automatically adjusts for misalignments between the electromagnet and armature. However, there is no provision in this patent for sensing an attempt to open the door with which the lock is used, nor is there any provision for detecting whether or not the door is secure. Both U.S. Pat. Nos. 4,516,114 and 4,297,512, disclose provisions for sensing if a door equipped with an electromagnetic lock is secure. However, neither patent discloses a provision for detecting an attempt to open a door, which detection is necessary if a delayed opening arrangement is to be utilized. In U.S. Pat. No. 4,516,114, the current between two portions of the electromagnet is monitored to determine if the armature is in contact therewith. However, in this patent the security of the electromagnetic lock may be compromised by a sheet of aluminum foil. In U.S. Pat. No. 4,287,512 Hall cells are used to monitor magnetic flux in the electromagnet lock to determine if there has been or is an attempt to defeat the lock by taping or applying an external counter-magnetic field. However, with this arrangement there is no provision for detecting reduction of magnetic holding force due to skewing of the armature with respect to the electromagnet. Moreover, there is no suggestion in this patent of a provision for coordinating the operation of two types of sensors used with magnetic locks.

SUMMARY OF THE INVENTION

In view of the deficiencies of the prior art, it is a feature of the instant invention to provide new and improved apparatus for indicating that an attempt is being made to open a door equipped with a magnetic lock; that an attempt has been made to defeat the magnetic lock, and/or that the magnetic lock for some reason is not secure.

In order to accomplish these feature, the instant invention contemplates a door locking arrangement wherein an armature is mounted on a door and an electromagnet is mounted on an adjacent door jam. A switch is mounted on the door jam and a switch operator on the door for operating the switch in response to movement of the door. The switch is associated with a circuit which indicates the following conditions:

1. the door is closed; and
2. an attempt is being made to move the door from a closed position to an open position.

In accordance with a preferred embodiment, the switch is mounted in proximity with the electromagnet and the switch operator in proximity to the armature.

The instant invention further contemplates reed switches, juxtaposed with the electromagnet, which reed switches change mode when the armature is properly in contact with the electromagnet to indicate that the armature is being held by the electromagnet.

In order to assure proper contact between the armature and electromagnet, the armature is mounted loosely on the door so that it will float with respect thereto. This compensates for misalignment between the armature and electromagnet due to errors either in mounting the electromagnet or in the plumb of the door so as to allow door movement to trigger the time delay current.

In order to minimize misalignment of the door, both the electromagnet and armature are mounted on previously secured mounting plates.

BRIEF DESCRIPTION OF THE DRAWINGS

Various other objects, features and attendant advantages of the present invention will be more fully appreciated as the same becomes better understood when considered in connection with the accompanying drawings, in which like reference characters designate the same or similar parts throughout the several views, and wherein:

FIG. **1** is a perspective view of an electromagnetic lock according to the instant invention, installed in a door jam for locking a door;

FIG. **2** is a front view of the electromagnet lock assembly which is mounted on the door jamb of FIG. **1**;

FIG. **3** is a cross-section of the electromagnet lock assembly taken along lines **3—3** of FIG. **2**;

FIG. **4** is a cross-section of the electromagnet lock assembly taken along lines **4—4** of FIG. **3**;

FIG. **5** is a cross-section of the electromagnet lock assembly taken along lines **5—5** of FIG. **3**;

FIG. **6** is a cross-section of the electromagnet lock assembly taken along lines **6—6** of FIG. **3**;

FIG. **7** is a schematic circuit diagram of a monitoring circuit used with the electromagnetic lock assembly of FIG. **1**, and;

FIG. **8** is a perspective view of a template used to position mounting plateds for the armature and electromagnet of the lock assembly.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. **1**, there is shown a wall **10** which is used to separate an interior space **11** from an exterior space **12**. The wall has a door frame **13** mounted therein in which a door **14** is mounted to swing about hinges from a closed position to an open position in the direction of arrow **17**.

In the illustrated embodiment, the door **14** is equipped with standard panic lock hardware **18** including a panic bar **19**. Normally, upon pressing the panic bar **19**, the panic lock hardware **18** undogs or retracts a bolt **18***a* allowing the door **14** to swing open in the direction of the arrow **17**.

In accordance with the instant invention, opening of the door **14** is further controlled by a magnetic lock, designated generally by the numeral **20**, which lock includes an armature, designated generally by the numeral **21**, and an electromagnet assembly designated generally by the numeral **22**. The electromagnet assembly **22** is mounted on the door frame **13** in an upper corner, preferably beneath and behind a top door jam **24** and inside and behind a side door jam **26**. The armature **21** is preferably mounted on the door **14** adjacent the top edge **28** of the door and the free edge **29** of the door. When the door **14** is closed and the electromagnet **22** assembly is energized, the armature **21** is held by the electromagnet **22** with approximately 1200 pounds of force so that the door **14** cannot be forced open by a person inside the enclosure **11**. There are several other companies producing locks having an electromagnet assembly **22** and an armature **21** suitable to supply the holding force necessary to secure the door **14** of the instant invention in a closed position.

In accordance with the features of the instant invention, the electromagnet assembly **22** is equipped with a switch, designated generally by the numeral **35**, which switch may be conveniently positioned adjacent to the electromagnet assembly **22**. As will be further explained hereinafter, the armature **21** has structure thereon for engaging and operating the switch **35**. Consequently, the switch **35** is used to sense if there is an attempt to open the door.

Referring now to FIGS. **2–6**, in order to conveniently mount the electromagnet assembly **22** to the door jam **13** and the armature **21** to the door **14**, a mounting plate **23** is provided for the electromagnetic assembly **22** and a mounting plate **24** is provided for the armature **21**. The plate **23** has a plurality of counter-sunk holes **25** therein, perhaps eight in number, each of which receives a mounting screw for securing the mounting plate **23** to the door jam **13** with, for example, self-taping screws **25′** if the door jam **13** is metal. As is seen in FIGS. **5** and **6**, the mounting plate **23** also has a bore **26** therethrough, through which pass electrical leads **27** used for energizing the magnetic assembly **22** and for monitoring control circuitry associated therewith. The mounting plate **23** also has a pair of threaded bores **28** which receive machine screws **28′** (see FIG. **2**) in order to secure the electromagnetic assembly **22** to the plate **23** after the plate has been mounted on the door jam **13**.

The mounting plate **24** for mounting the armature **21** has a plurality of counter-sunk screw holes **29** therethrough which receive mounting screws **29′** that secure the mounting plate **24** to the door **14**. The mounting plates **23** and **24** are secured to the door jam **13** and the door **14**, respectively by marking the screw holes in the door jam and door with a template when the door is closed. With magnetic locks, it is very important that the electromagnetic assembly **22** and armature **21** be properly aligned. It is much easier to properly align plate-type mounting members than to attempt to properly align operational components, such as the electromagnetic assembly **22** and the armature **21**. Since the mounting plates **23** and **24** have fixed screw holes **28** and **30** for mounting the electromagnetic assembly **22** and

armature **21** respectively, proper positioning of the electromagnet and armature can be accomplished by simply properly positioning the mounting plates. A well known and widely practiced approach to mounting one member on another is to use a template for correctly positioning screw holes. Such a conventional template is shown in FIG. **8** with holes **25** which identify the proper location for screw holes.

The electromagnet assembly **22** is rigidly secured to the mounting plate **23** by the bolts **28'**. However, as seen in FIG. **4**, the armature **21** is permitted to float in the "X" direction with respect to the mounting plate **24**. This is accomplished by configuring the bolts **30'** substantially as shoulder bolts wherein sleeves **33** surround the bolts **30'** and received in round holes **34** in the armature **21**. The heads **35** of the bolts rest within bores **36** in the armature **21**. Preferably, the bolts **30'** have nuts **31'** into which they are threaded when mounting the armature **21** on the mounting plate **24**. Preferably, a pair of coil springs **40** (only one of which is shown) are received in bores **41** in the armature **21** to keep the armature **21** projected toward the electromagnet assembly **22**.

Referring now further to FIGS. **2–6**, wherein the specific details of the electromagnetic lock **20** are set forth, it is seen that the components of the electromagnetic assembly **22** are contained within an aluminum housing **49** while the armature **21** is shielded along its lower edge by a flange **51** which is integral with the mounting plate **24**. Consequently, all working parts of the electromagnetic lock assembly **20** are enclosed so as to minimize the chances of damage and to discourage tampering. The electromagnetic assembly **22** includes an electromagnet **55** which is held within the housing **49** by a pair of machine screws **56** through the top flange **57** of the housing and a pair of screws **58** through the bottom flange **59** of the housing. Preferably, the electromagnet **55** is comprised of a multiplicity of "E"-shaped laminations held in abuttment with one another in accordance with conventional procedures. In accordance with a conventional arrangement, a coil **61** surrounds the middle leg **62** of the electromagnet **55** and is embedded in potting material **64**. The coil **61** has leads **62** extending therefrom which are connected to the circuitry of FIG. **7**, as will be further explained hereinafter.

In accordance with the instant invention, the core of the electromagnet **55** has a pair of slots **67A** and **67B** therein which are laterally spaced from one another. The slots **67A** and **67B** are generally perpendicular to the upper and lower surfaces of the core of the electromagnet **55** and are disposed on the rear face **55A** disposed opposite the front face **55B** which attracts the armature **21**. A first reed switch **70** is contained in the slot **67A** adjacent to the bottom of the slot (see FIG. **4**), while a second reed switch **71** is positioned in the slot **67B** adjacent to the top of the slot (see FIG. **6**). The reed switches **70-71** are installed on printed circuit boards and bonded to the rear face **55A** of the electromagnet **55** so that the reed switches may be removed for realignment. The reed switches **70** and **71** detect the level of magnetic flux in the electromagnet **55** to determine whether or not the flux is at a predetermined level. The predetermined flux level is determined as the flux level within the slots **67A** and **67B** which exits when the armature **21** is in direct abuttment with and properly aligned with the electromagnetic **55**. If the armature **21** is skewed with respect to the electromagnet **55**, one or the other of the magnetic reed switches **70** or **71** will not close, indicating that the armature **21** is not properly aligned with the electromagnetic **55**. If, for example, a sheet of paper, strip of tape or perhaps a strip of aluminum foil is placed between the armature **21** and the electromagnetic **55** so as to weaken the attraction between the armature and electromagnetic, the reed switches **70** and **71** will again pick up the reduction in the magnetic field and remain open.

Adjacent to the electromagnetic **55** is an area **80** which accommodates the switch **35** and the printed circuit board **81** which accommodates the electrical circuitry set forth in FIG. **7**. Positioned in the area **80** is a plunger (see FIGS. **3** and **5**) **82** which is biased outwardly in the "X" direction by a coil spring **83**. A rod **84** passes through the plunger **82** and is engaged in a slot **85** in a flange **86** so as to limit travel of the plunger to the length of the slot. The plunger **82** is received in a sleeve **87** mounted in a bracket **88** to which the printed circuit board **81** is secured by a pair of screws **90** which pass through a pair of insulating spacers **91**. Secured to the flat rear end of the plunger **82** is a permanent magnetic **92**, which is aligned with a Hall cell **93**. When the door is opened, the spring **83** projects the plunger **82** so as to distance the permanent magnetic **92** from the Hall cell **93**. Upon engaging the round end **94** of the plunger **82** with the block **95** on the armature **21**, the permanent magnetic **92** is moved into closer proximity with the Hall cell **93** generating an electrical signal which indicates that the door **14** is closed with respect to the door jam **13**.

When one presses on the door **14** and the electromagnet **55** is energized, the armature **21** will remain in tight abuttment with the face **55B** of the electromagnet **55**. However, pressure against the door **14** will cause the mounting plate **24** to move away from the armature **21** and the electromagnet **22**. As is seen in FIGS. **3** and **5**, attached to the mounting plate **24** is a block **95** which engages the end of pin **94**. As the block **95** moves outwardly in the "X" direction away from the mounting plate **24**, the plunger **82** also moves in the "X" direction under the bias of spring **83**. This, of course, moves the magnet **92** out of proximity with the Hall cell **93**, causing the Hall cell **93** to generate a signal to a control circuit **100** (see FIG. **7**) indicating that an attempt is being made to open the door.

Referring now to FIG. **7**, operation of the control circuit **100** follows the operation of the Hall cell **93**. Upon closing the door **14**, the block **95** engages the plunger **82** to move the magnet **92** into close proximity with the Hall cell **93**. This causes a low to occur on line **101** which is applied to the inputs **1** and **2** of NAND gate A the results in a high on output line **102** which is applied to pin **5** of NAND gate B. Since there is already a high on pin **6** of NAND gate B, NAND gate B has a low output on line **103** which is applied to the pins **12** and **13** of NAND gate C. NAND gate C has a high output applied over line **104** which turns transistor Q_2 on. The collector of transistor Q_2 goes low and pulls to ground which causes the power supply to provide a high on line **111** so as to energize the coil **61** in the electromagnet **55** and build the magnetic field in the electromagnet. The magnetic field attracts the armature **21** and holds the armature **21** tight against the face **55B** of the electromagnetic (see FIGS. **3–5**).

If there is tape, a sheet of paper, or another shim placed on either the face **55B** of the electromagnetic or on the face of the armature **21** so as to reduce the elec-

tromagnetic field, the reed switches **70** and **71**, will not close. Moreover, if the armature **21** is skewed with respect to the face **55B** of the electromagnet **55**, then one of the reed switches **70** and **71** may close but the other will remain open. The condition of the Reed switches **70** and **71** is monitored by pin **6** of NAND gate B in conjunction with Q1 and Q3/IC2.

Upon applying current to line **111** to energize the coil **61** of the electromagnet **55**, a high is applied on line **115**. The high on line **115** is applied over line **116** to Q3 which turns off pnp transistor, Q3. Simultaneously, line **118** is momentarily pulsed high through capacitor C2 into pins **8** and **9** of NAND gate D creating a low pulse on line **119** to pin **2** of IC2. IC2 initiates a high from pin **3** to npn transistor Q1 over line **120**, turning on Q1 and shunting the reed switches **70** and **71**. This creates a high on line **121** and line **116** assuring a high on pin **6** of NAND gate B. The high on pin **6** of NAND gate B will remain for the predetermined timing set by C6 and R6, about two and one-half seconds, allowing the electromagnetic flux field to build up in electromagnet **55**. When the two and one-half seconds expires, IC2 pin **3** goes low and a low goes out on line **120** to Q1 to turn Q1 off. When Q1 is turned off, the signal on pin **6** of NAND gate B is now controlled by the reed switches **70** and **71**. If the reed switches **70** and **71** are both closed, a good magnetic bond between the electromagnet **55** and armature **21** is indicated and the reed switches are shorted out and a high remains on line **121**, which high, when applied to NAND gate B along with the high on line **102**, maintains the low on line **103**, keeping transistor Q_2 on and maintaining power to the coil **61** of the electromagnetic **55**. If the reed switches **70** and **71** are open, a low results on line **121** which results in a high on line **103** and a low on line **104** which turns transistor Q2 off, triggering the time delay circuit which initiates the fifteen to thirty second time delay cycle as is set forth by the reference.

If the door **14** is closed and an attempt is made to open the door while the electromagnet **55** is energized and the armature **21** is in place, then the block **95** moves away from the electromagnetic assembly, allowing the pin **82** to move the permanent magnetic **92** away from the Hall cell **93**. The Hall cell then applies a high to line **101** which is inverted by the NAND gate A and results in a low on line **102**. A low on line **102** results in a high on line **103** and a low on line **104** which turns transistor Q2 off. This starts the time delay circuitry **130** or, optionally, if one wishes to lock up the door without a time delay, sets off an alarm. The time delay circuitry **130** is connected to a power supply for the coils **61** of the electromagnet **55** through BR1 so as to interrupt power to the magnet **55** after a selected time interval which may be, perhaps, an interval of 15–30 seconds. The particular configuration that the time delay circuitry may assume is set forth in the related patents and patent application aforementioned in this discussion, which patents and patent application are incorporated herein by reference.

Considering the general time delay circuitry **130**, more specifically, the output of the transistor Q_2 is connected via line **152** to the time delay chip **153** in accordance with a first embodiment of the invention, or connected directly to an indicator or alarm **154** via a dotted line **156** in accordance with a second embodiment of the invention. The time delay chip operates a switch **158** disposed in the power line **111** between the electromagnet power supply **160** and the coils **61** of the electromagnetic **55** so as to open the switch after a preselected time interval of perhaps 15 to 30 seconds has expired. The details of the time delay system are set forth most specifically in co-pending U.S. application Ser. No. 423,523, now U.S. Pat. No. 4,540,208. In accordance with principals set forth in the references incorporated by reference, specifically U.S. Pat. No. 4,540,208, the switch **158** is closed upon sensing that the door **14** is closed due to a high on line **104**. However, when there is a low on line **104**, the time delay chip initiates its count. As in the other patents listed under related patents, the time delay chip **153** is connected to an alarm **162**, located at a control station and/or over the door **14**, which is activated once the time delay starts its count. A switch **163** is provided in the line **111** to open the circuit between the electromagnet **55** and the power supply **160** if one wishes to deactivate the electromagnetic lock **20** or for some reason to by-pass the time delay chip **153**. If necessary or desired, a smoke detector **165** or other emergency condition sensor may be connected to the line **111** to operate the switch **163** and to cut power from the power supply **160** to the electromagnet **55**. Again, the appropriate circuitry for accomplishing this is also set forth in the aforementioned patents and more specifically set forth in co-pending U.S. patent application. Ser. No. 423,523, now U.S. Pat. No. 4,540,208.

From the foregoing description, one skilled in the art can easily ascertain the essential characteristics of this invention, and without departing from the spirit and scope thereof, can make various changes and modifications of the invention to adapt it to various usages and conditions.

What is claimed is:

1. In a magnetic lock in combination with a door mounted in a door frame for locking the door with respect to the door frame:

an electomagnet mounted in the frame, the electromagnet having a core with oppositely facing front and rear surfaces, the core having a coil looped therein and a pair of laterally extending slots extending therein adjacent the rear surface thereof;

a power supply connected to the electromagnet for energizing the electromagnet;

an armature mounted on the door for engaging the electromagnet adjacent the front surface of the core when the door is shut;

sensing means disposed in the electromagnet for sensing if the armature is engaging the electromagnet, the sensing means including a pair of reed switches spaced laterally from one another; the reed switches being positioned in the slots with one reed switch adjacent to the bottom of the first slot and the other reed switch adjacent to the top of the second slot, wherein the reed switches in concert monitor magnet flux to detect whether the armature is skewed with respect to the electromagnet or whether the armature is directly in contact with the front surface of the electromagnet;

means for connecting the reed switches in series with one another;

circuit means including the reed switch connecting means, the circuit means including the reed switch monitoring means for detecting when at least one reed switch is open and when both reed switches are closed; and

indicating means connected to the reed switch monitoring means for indicating the condition of the

reed switches so as to indicate whether or not the armature is in engagement with the front surface of the electromagnet to securely lock the door.

2. The device of claim 1, further including timing means connected with the reed switch monitoring means, the timing means having a first input for starting a time interval and an output for monitoring the condition of the reed switches wherein the output for monitoring the condition of the reed switches is activated after a selected time interval, whereby monitoring of the reed switches occurs only after the door has been closed for the selected time interval.

3. The magnetic lock of claim 2, wherein a second switch having an output connected to a time delay and alarm is included, which second switch is separate from the reed switches and monitors the position of the door with respect to the door frame and the electromagnet rather than monitoring the magnetic flux of the electromagnet; the door lock further including a NAND gate having as one input the line connecting the reed switches and as the other input the output of the separate switch, wherein both the reed switch circuit and the second switch circuit must be properly activated to maintain controlled energization of the electromagnet and to maintain an indication that the door is securely locked.

4. In a magnetic lock in combination with a door mounted in a door frame, wherein the magnetic lock includes an electromagnet mounted on the door frame; and armature mounted on the door for engagement by the electromagnet and a power supply connected to the electromagnet to magnetically hold the armature, the improvement comprising:

a first mounting plate for mounting the electromagnet on the frame, the first mounting plate including holes therethrough receiving screws for securing the mounting plate to the door frame and having screw threaded holes at spaced locations therein;

a magnetically insulated housing for containing the electromagnet; the housing having means thereon for receiving at least two screws, which screws are threaded into the screw threaded holes in the first mounting plate;

means for securing the electromagnet in the housing;

a second mounting plate;

screw holes through the second mounting plate receiving screws for fixedly securing the second mounting plate to the door;

means for loosely securing the armature to the second mounting plate; wherein when the armature is magnetically held in contact with the electromagnet, the door may move relative to the door frame;

spring means disposed between the armature and the second mounting plate for urging the armature away from the second mounting plate and toward the electromagnetic when the door is closed;

a block mounted on the second mounting plate in spaced relation to the armature;

a plunger disposed on the first mounting plate in spaced relation to the electromagnet which plunger is in alignment with the block and is depressed by the block when the door is closed, and

a switch operated by the plunger for providing a signal indicative of the position of the door, wherein when an attempt is made to open the door while the electromagnet is energized, the block moves away from the electromagnet while the armature remains in engagement with the electromagnet thereby allowing the plunger to operate the switch so as to provide the signal even when the door is locked by the electromagnet.

5. The magnetic lock of claim 4, wherein the second mounting plate includes a lower flange extending normally thereto, which lower flange covers the lower edge of the armature.

6. The magnetic lock of claim 4, wherein the first mounting plate has a hole therethrough which is in alignment with a hole through the housing, wherein leads from the electromagnet may be carried therethrough into the door frame.

7. The magnetic door lock of claim 4, further including means disposed between the power supply and the electromagnet for interrupting current to the electromagnet, the interrupting means including a time delay circuit connected to the switch means which time delay circuit interrupts the current after a selected time interval upon receiving the signal from the switch.

8. The magnetic door lock of claim 7, further including a pair of spaced, serially connected reed switches disposed adjacent to the electromagnet for detecting if the armature is properly engaged with the electromagnet by monitoring the magnetic flux thereof and indicating means connected to the reed switches for indicating if the magnetic flux drops below a selected level.

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